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(54) A process for preparing printed sheets with optical effects.

(57) The motifs (4) deemed desirable are printed in a first step on one of the surfaces of a sheet of paper (2) by any conventional system. Thereafter, in a second step, there is applied to the printed surface a resin, thermoplastic lacquer or other transparent material (6) which impregnates the surface of said sheet (2), after which, in a third step, at least one area of the thus treated surface is engraved by pressure and heat to produce the said effects. Finally the continuous sheet (2) is cut into units (9). The resin (6') is polymerizable with ultraviolet rays and is polymerized at the same time as the engraving is effected.

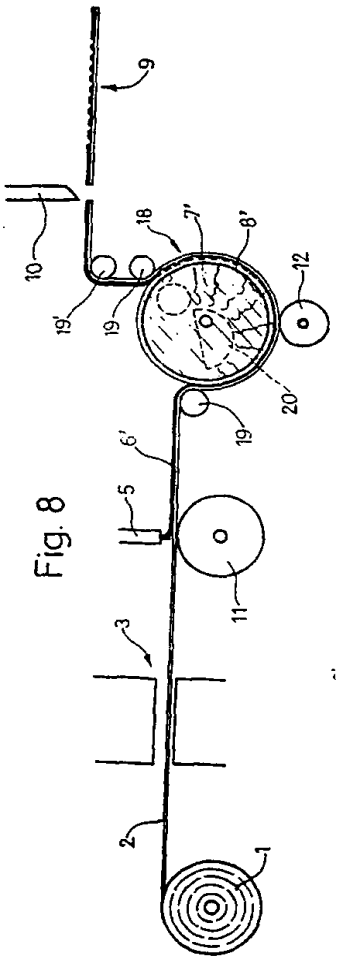


Fig. 8

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The present invention relates to a process for the preparation of printed sheets with optical effects, of diffraction and reflection of light.

There are currently various processes through which these effects are obtained on sheets having a front ply of plastics material suitably worked as a lens, behind which there are motifs which are viewed through said ply, providing the said effects.

Some of said processes are based on holographic reproduction, by engraving said reproduction on the rear surface of the plastics ply by heat and pressure and covering it with a reflective ply which allows the image to be viewed in 3-D through said plastics ply.

Other known processes are based on printing the motif to be viewed on a suitable sheetlike substrate, or directly on the rear surface of the plastics ply. The motif is printed with various stepped images or with multiple or offset photographs to obtain, through said ply, effects of images in different positions and/or depth after engraving striations or a reticule which forms optical lens on the front surface of the plastics ply.

With these processes and other known ones, sheets provided with the above effects are obtained, but they are of limited application due mainly to a thickness which makes them rather inflexible and rich is a consequence of the nature of the said plastics ply.

The sheets with effects which are obtained by the process of this invention may be very thin and flexible and their applications are unlimited, since said process is implemented on paper or paperboard or any other absorbent material, with the said effects being provided on the sheets over the whole surface or on one or several areas thereof, the application of the process being of interest, for example, in banknotes and important documents, since these effects are practically impossible to falsify.

Likewise, the said thinness and flexibility of the sheets obtained with this process allow them to be manufactured as a continuous sheet, with subsequent shearing or die-cutting , whereby a higher production rate at a better price is obtained.

In view of all this, the process comprises a first step in which at least one side of the said sheets is printed by any conventional system with the desired motifs or illustrations, for the application thereto in a second step, on the whole or on a part of the printed surface, of a resin, a thermoplastic lacquer or other transparent material which allows a third step in which the engraving is performed on the resin-coated portion of said printed surface by heat and pressure, to produce the said effects.

Where a 3-D image is intended, the engraving will be effected with an ultrafine interference engraving, the sheets having been advantageously printed on a reflective ply.

Where a multiple image and/or depth effects are intended, striations or a grid forming cylindrical lenses will be engraved on the thermoplastic lacquer or resin, allowing the motifs previously printed on the sheets to be viewed with the said effects.

Both types of engraving, namely the ultrafine interferences and the cylindrical lenses, of the sheets may be carried out advantageously in corresponding different areas thereof, to give sheets in which one area will have 3-D effects and another will have multiple image and/or depth effects.

The optical effects may also be engraved on plastics sheets or any other material, be it absorbent or not, avoiding the subsequent slow drying or polymerization of the resin meaning deformation of the engraving on the surface of the printed sheets impregnated with said resin, which would prevent the contemplated optical effects from being obtained.

Depending on this, a UV ray polymerizable resin or varnish is used, with both the engraving on the resincoated side of the sheets which will produce the optical effects and the drying of the resin being carried out at the same time.

Therefore, the calender used for engraving said sheets has suitably mounted in the interior thereof at least one ultraviolet ray source which projects them on the resincoated surface of the sheet which is being engraved at that same time in the calender which, to allow the passage of said rays, has the cylinder and the peripheral die plate thereof transparent.

Likewise, the ultraviolet ray source may be mounted outside the calender, directing it suitably with the sheet interposed therebetween, whereby said source is arranged behind the sheet, without any need for the parts of the calender to be transparent.

In both variants, the ultraviolet rays projected by the respective sources polymerize the resin-coated surface of the sheet practically at the same time as it is being engraved, it being possible to ensure the drying of said sheet by urging the sheet against the calender while rotating part of the way with it before release therefrom and providing a ventilation system, suitably mounted in each case, to dissipate the heat caused by the ultraviolet rays and which could prevent the perfect polymerization of the sheet.

When printing the sheets, reserve areas are contemplated where the resin or the like will thereafter be applied directly. The sheets may be printed before or after the application of the resin, with the consequent reserve areas, as desired in each case.

These and other features will be better understood from the following detailed description, to facilitate which there accompany the present description three sheets of drawings in which certain embodiments cited only as non-limitative examples of the scope of the invention have been illustrated.

In the drawings:

Figure 1 is a schematic of the process of the in-

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vention;

Figure 2 is a front elevation view of a sheet having an area with an ultrafine interference engraving;

Figure 3 is a cross section view of the sheet of Figure 2 along the line III-III thereof;

Figure 4 is a front elevation view of a second sheet having an area with a lenticular engraving;

Figure 5 is a cross section view of the sheet of Figure 4 along the line V-V thereof;

Figure 6 is a front elevation view of a third sheet having one area with an ultrafine interference engraving and another lenticular engraved area;

Figure 7 is a cross section view of the sheet of Figure 6 along the line VII-VII thereof;

Figure 8 is a schematic of the process in which the ultraviolet ray source is included in the interior of the calender;

Figure 9 illustrates part of the schematic corresponding to the calender with the ultraviolet ray source outside the calender;

Figure 10 illustrates an alternative embodiment of the part of the schematic corresponding to the calender and to the device which applies the resin to the sheet; and

Figure 11 is a schematic of the process with the printing operation in a step subsequent to that of the resin application.

The illustrated process for preparing printed sheets with optical effects is carried out from a reel 1 of absorbent paper 2, which is supplied to a lithographic, silk screen process or other printing means 3 which prints the pertinent motifs or illustrations 4 on one surface thereof.

After being printed, the paper 2 is fed through a device 5 which applies a lacquer, thermoplastic resin or other material 6 thereto, which impregnates the surface thereof, the thus impregnated paper 2 then being fed through a calender formed by a hot roll 7 comprising on the surface thereof a die plate 8 with which it engraves the ultrafine interferences or the cylindrical lenses on the resin-coated surface of the paper, this being finally cut into unit sheets 9 by a shears 10.

Both the device 5 supplying the resin 6 and the engraving roll 7 are provided thereunder with respective backing rolls 11 and 12 for the paper 2, on which said roll 7 applies an ultrafine interference engraving 13 or striations or grid 14 forming lenses 15, depending on the die plate 8 mounted in accordance with the optical effects to be provided on the sheets which will be obtained from the paper 2.

Said roll 7 may also be provided with a die plate 8 prepared to perform both engravings or, if preferred, two rolls 7 will be arranged one after the other, each provided with its corresponding die plate 8 for carrying out the said engravings with which the 3-D images or the effects of multiple image and/or depth, as the case may be, are obtained. Some of these engravings may be made on illustrations already printed on the paper 2 by the means 3 and which in combination with the engraving will provide the pertinent effect.

It is gathered from the foregoing that the sheets 9 obtained with the present process may have different engravings as reflected in the three sheets illustrated in Figures 2 to 7 and which are referenced 9a, 9b and 9c to differentiate them, the first one comprising an area 16 having an ultrafine interference engraving with 3-D effects, the second one an area 17 with lenticular engraving with double image and/or depth effects and the third one having two areas 16 and 17 with respective engravings of both classes.

As is logical, the sheets having a single type of engraving may have it over several portions of the surface thereof or over the whole of it, and the sheet which combines both engravings may have more engraved areas and with more of one type than of the other, depending on desire or needs.

It is also contemplated that the process of the invention may be implemented on loose leaves instead of on a reel.

According to Figure 8, after being printed, the paper 2 is fed, while resting on the pertinent roll 11, under the device 5 which applies a resin or varnish 6' thereto. This material, which may be polymerized by ultraviolet rays, impregnates the surface of the paper, which is then fed, resin-coated, to a calender 18 which will apply thereto the engraving producing the optical effects, the resin-coated paper being wrapped on the periphery thereof and accompanying it in part of its rotation until being released from the calender to be fed thereafter to the shears 10 which will cut it into already engraved unit sheets 9.

The paper 2 is pressed against the calender 18 by the backing roll 12 arranged under said calender, there only being necessary a further two guide rolls 19 for the paper 2 where it enters and leaves the said calender, since the resin facilitates its adhesion thereto. Likewise, a further roll 19' may direct the paper to the shears 10.

During the operation of the calender 18, the resin 6' is almost completely dry or polymerized when the engraving starts. This polymerization is completed during a portion of the rotation of the calender, for which purpose the calender has the component roll 7' and the peripheral die plate 8' transparent, the former being preferably of glass and the latter of polyester, with an ultraviolet ray source 20 being suitably mounted in the interior of the said roll 7'. Said rays are projected by the source against the resin-coated surface of the paper 2 during its part rotation with the calender 18.

The ultraviolet ray source may also be installed outside the calender 18 (Figure 9), and acts on the paper 2 from behind. In this case, the calender may be opaque and formed by conventional roll 7 and per-

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ipheral die plate 8, while the source may advantageously be formed by several units 20' disposed around the calender 18, coextensively with the portion where the paper 2 moves.

A fan 21 mounted inside the calender 18, or outside it, depending on the type of calender used, dissipates the heat of the ultraviolet rays radiated on the paper 2, aiding to perfect polymerization. In the latter case, a shield 22 directing the fan 21 towards the sources 20' is installed.

On the other hand, the resin 6' may advantageously be applied to the paper 2 practically at the same time as the latter is delivered to the calender 18 (Figure 10) and also be radiated and pressed by the backing roll 12 at the same time, whereby, further to carrying out everything at the same time, the size of the plant and the engraving process time will be reduced.

As seen in Figure 11, the process for preparing printed sheets with optical effects starts from the reel 1 of paper 2, which is fed under the device 5, supported on the roll 11, where a UV polymerizable resin or varnish 6' is applied, leaving reserve areas 6".

Thereafter the thus resin-coated paper is fed to a calender 18 where the optical effect producing engraving is effected, the paper being applied to the periphery of the calender and adhering thereto during part of the rotation thereof, after which it is released to be fed under a printing means 3' which prints the desired motifs 3" on the reserve areas 6".

Finally, the resin-coated, engraved and printed paper is fed to a shears 10 which will cut it into unit sheets 9.

During the operation of the calender 18, the resin 6' is practically dried or polymerized at the same time as the engraving is effected. To this end, the component roll 7' and peripheral die plate 8' of the calender are transparent, and have mounted therein at least one ultraviolet ray source 20 which projects them against the resin-coated surface of the paper 2 as it is fed through the calender 18.

It is understood that, according to the invention, the engraving process for the preparation of sheets with optical effects (holographic effects, effects based on a lens producing a double image or depth, or other special effects), may be implemented with or without heat and pressure.

Claims

1.- A process for preparing printed sheets with optical effects, said sheets comprising a ply of plastics material worked as a lens through which motifs provided therebehind are viewed, characterized in that said sheets (2) are made from non-plastic absorbent material and in a first step they are printed, at least on one surface thereof, by any conventional system (3) with the pertinent motifs or illustrations; in a second step there is applied over the printed surface a resin (6), thermoplastic lacquer or other transparent material which wholly or partially impregnates the surface of the sheet (2), after which the engraving (7-8) which will produce the said optical effects is carried out in a third step on the impregnated area with heat and pressure.

2.- The process for preparing printed sheets with optical effects of claim 1, wherein the sheets (2) are made from paper and the area to be engraved, once the resin (6) or thermoplastic lacquer has been applied, receives an ultrafine interference engraving (13) which will determine the viewing of the engraving in 3-D when observed from the treated surface of the sheet (2).

3.- The process for preparing printed sheets with optical effects of claim 1, wherein the sheets (2) are made from paper and, once printed (3) and with the application of the resin (6) or thermoplastic lacquer, are engraved to form thereon striations or a grid (14) forming optical lenses (15) allowing the viewing, with multiple image and/or depth effects, of the motifs printed on the sheets (2).

4.- The process for preparing printed sheets with optical effects of claims 1 to 3, wherein the ultrafine engravings (13) and reticular lenses (15) allowing the said optical effects of the sheets, are both effected on corresponding different areas (16 and 17) thereof.

5.- The process of preparing printed sheets with optical effects of claim 1, wherein the sheets (2) used are made from any material, absorbent or not, and the resin (6') is polymerizable by ultraviolet rays and wherein the engraving on the resin-coated surface of the sheets (2) is effected at the same time as ultraviolet rays are radiated, with the pertinent means, on said sheets (2) for polymerizing the resin (6').

6.- The process for preparing printed sheets with optical effects of claim 5, wherein the means radiating the ultraviolet rays on the sheets (2) comprise, at least, one source (20) inserted and suitably mounted within the calender (18) applies the engraving producing the optical effects on said sheets, the roll (7') and die plate (8') comprising said calender being transparent.

7.- The process for preparing printed sheets with optical effects of claim 5, wherein the means radiating the ultraviolet rays on the sheets (2) comprise one or several sources (20') which, suitably mounted facing the calender (18), are arranged behind the sheet (2) on which at that time the engraving producing the optical effects is being made.

8.- The process for preparing printed sheets with optical effects of claim 5, wherein the resin (6') is applied to the sheet (2) adjacent the point of the calender (18) where the press roller (12) is acting, i.e. where the engraving of the resin-coated sheet is being effected, by incidence of the ultraviolet rays.

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9.- The process for preparing printed sheets with optical effects of claims 1 and 5, wherein the sheets (2) are previously printed on predetermined areas thereof leaving reserve areas where the resin (6') or like will be subsequently applied.

10.- The process for preparing printed sheets with optical effects of claim 9, wherein the sheets (2) are printed after the application thereon of the resin (6') or the like in which the corresponding reserve areas (6") have been provided for the said print (3").

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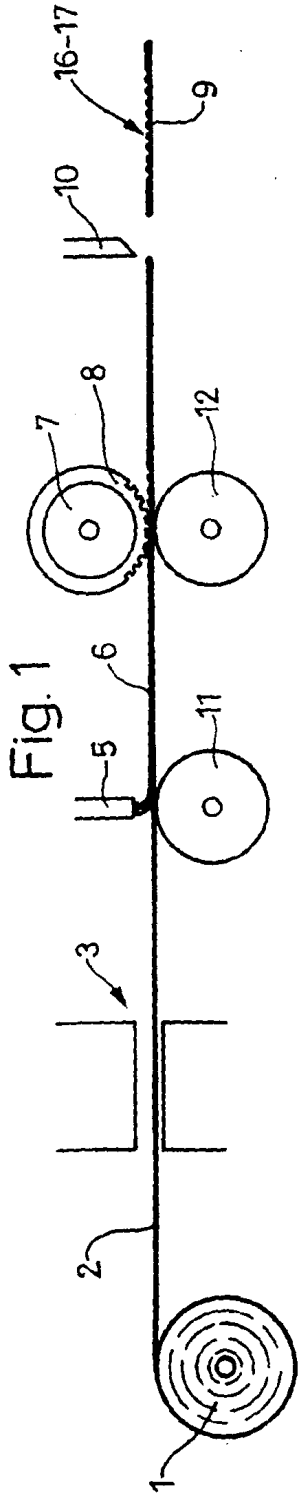


Fig. 1

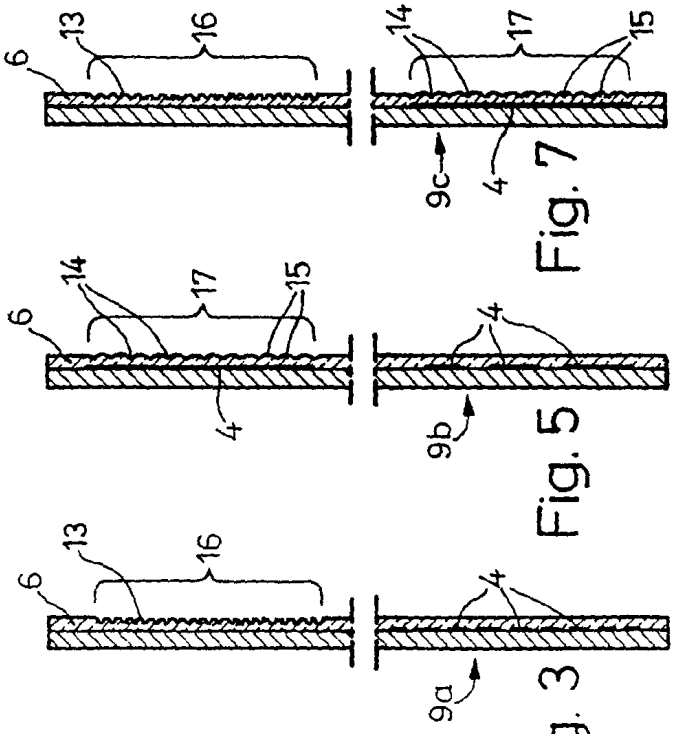


Fig. 7

Fig. 5

Fig. 3

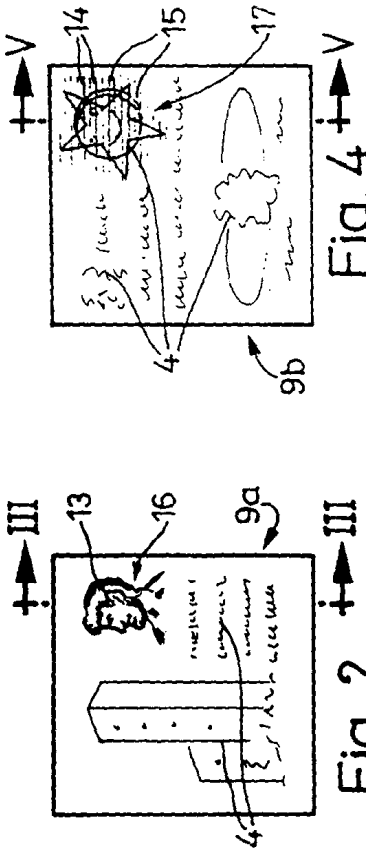


Fig. 4

Fig. 2

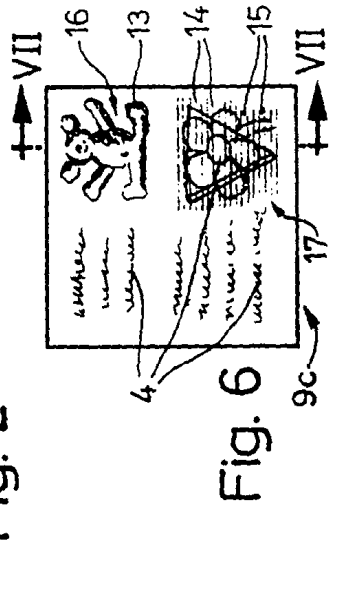


Fig. 6

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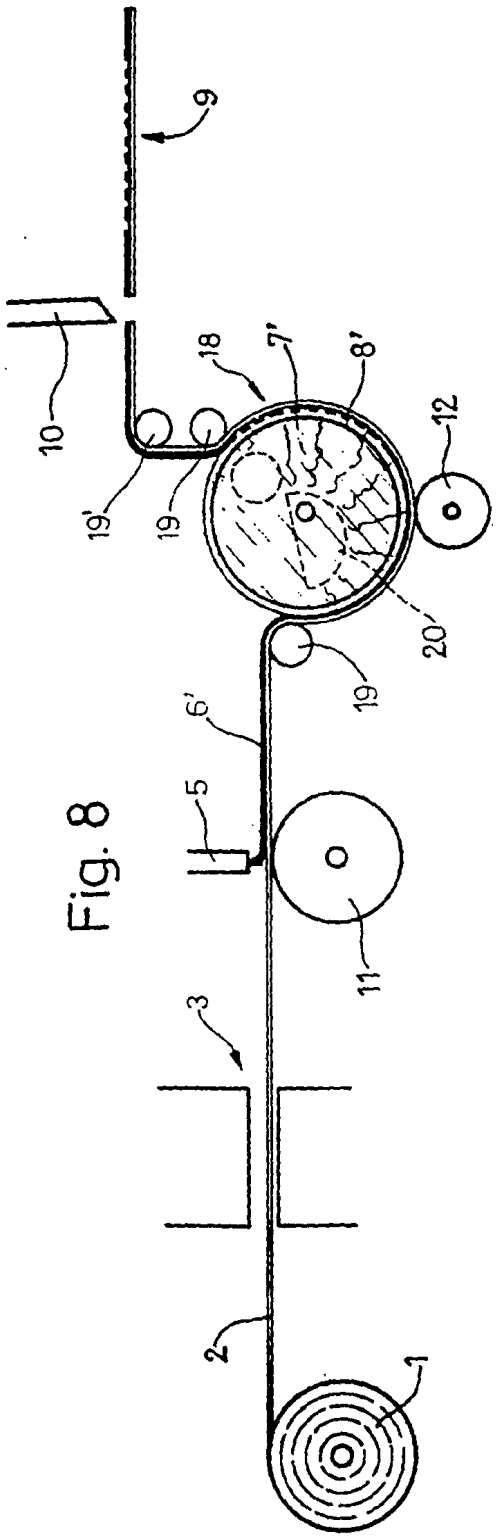


Fig. 8

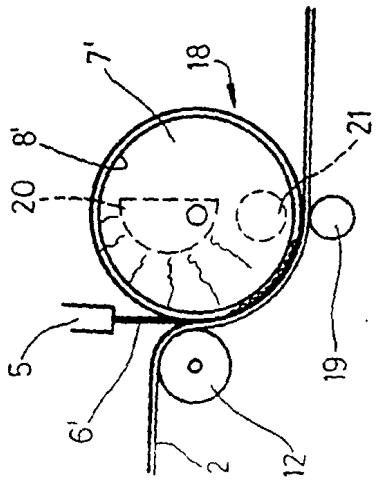


Fig. 10

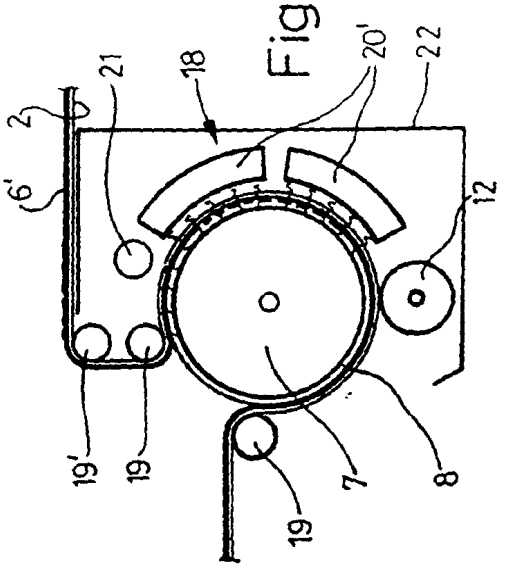


Fig. 9

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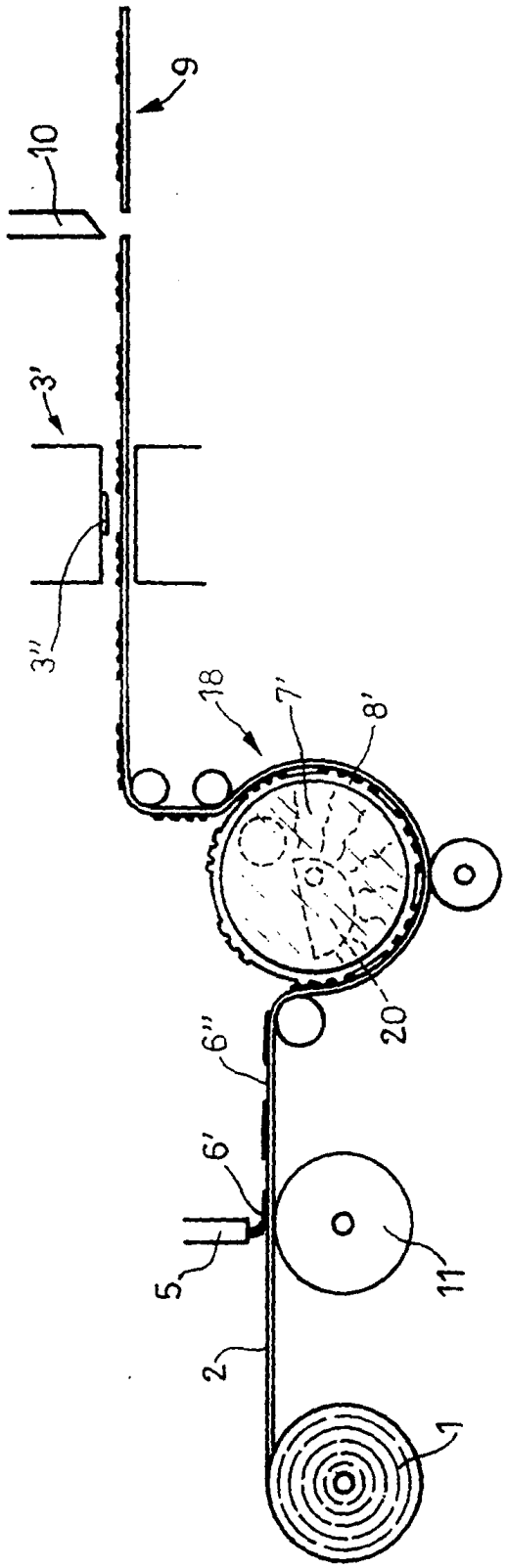


Fig. 11

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 92 50 0136

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	US-A-4 184 700 (GREENAWAY) * column 2, line 9 - line 55; figures 1,2 * ---	1,2 3,4	B42D15/10 B42D15/00
Y	DE-U-8 529 297 (GAO) * page 14, line 10 - page 19, line 31; figures 1-3 * -----	3,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B42D B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 JANUARY 1993	EVANS A.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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